

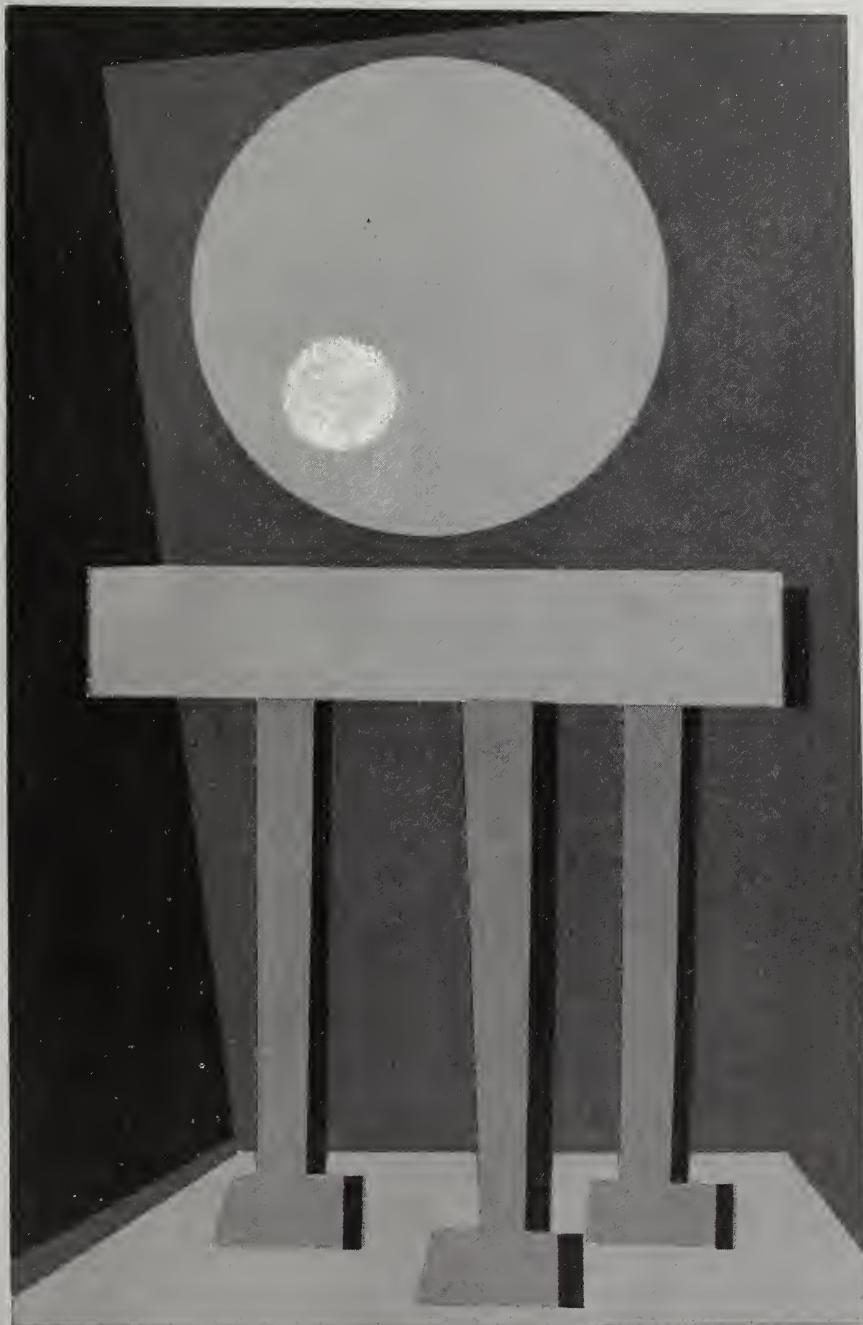
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AGRICULTURAL  
**Research**

U.S. DEPARTMENT OF AGRICULTURE



LASER BEAM  
AIDS AGRICULTURE  
Page 8

# AGRICULTURAL Research

April 1967/Vol. 15, No. 10

## Adapting Technology

Agriculture adapted the established ideas and methods of many sciences to give farmers electricity and automation, higher yields and meatier livestock, disease resistant crops and protective vaccines.

At the same time, agricultural researchers rode the scientific wave that brought America into the nuclear age, harnessing for agriculture the revolutionary developments of nuclear physics and electronics.

ARS scientists, for example, use nuclear energy to sterilize laboratory-reared insects, which are then released to mate with the natural population, thus producing no offspring. This technique eradicated the screwworm fly from the United States, and has proved a lethal weapon against various fruit flies.

They irradiate seeds to produce mutant plants with desirable characteristics for breeding, and they combine chemical treatments with radiation to produce extremely soft, stretchable cotton.

They invented one nuclear gage to measure stream sediment quickly and inexpensively and another to analyze egg fragility. The egg fragility gage will help poultry breeders select lines of layers with stronger eggshells.

And ARS researchers employ sound waves to measure the firmness of fruits and vegetables, and to detect pregnancy in sheep. They unleash radiofrequency energy to increase seed germination and to destroy insects in stored grain.

Now they are adapting the laser beam.

An ARS engineer found that the laser beam, a device invented in 1960 and already serving medicine, industry, and photography, could be incorporated into a machine that lays pipe underground for field drainage (page 8).

The beam controls the depth of the pipe, insuring that it remains level. In the future, the laser beam may achieve similar results in ditching, road grading, and land leveling.

As with nuclear energy, sound waves, and radiofrequency energy, ARS researchers may find even more diverse ways to benefit from the laser beam.

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*Editor: R. P. Kaniuka*

*Contributors to this issue:*

*H. L. Brinson, B. D. Carriere,  
E. H. Davis, Marshall Gall,  
M. B. Heppner, Gerald King,  
J. G. Nordquist, R. G. Pierce,  
N. E. Roberts, H. K. Street,  
D. M. Webb*

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Orville L. Freeman, Secretary  
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator  
Agricultural Research Service

MULTILATERAL ATTACK, ONE GOAL ...

## Curb*ing* THE ALFALFA WEEVIL

The alfalfa weevil, a pest accidentally introduced into the United States about 1904, has now spread to the Midwest where 65 million tons of alfalfa are grown annually.

For the present, farmers can reduce weevil damage by growing dense, vigorous stands; using pesticides; harvesting early—at full bud stage—if larvae, which do most of the damage, are discovered; and

*E. W. Martin, University of Maryland technician, operates the flaming rig developed by the University in cooperation with ARS.*  
BN-24974





*Alfalfa weevil larvae feeding on alfalfa leaf. Although the adult weevil feeds on alfalfa, the larvae cause most of the damage.*

removing hay promptly from the field to expose larvae to the hot sun which kills them.

ARS scientists are seeking ways to attack the weevil through research on flame treatments, resistant varieties, and natural predators.

## **FLAME TREATMENT**

The weevil's vulnerability to heat may offer a nonchemical approach to its control, ARS entomologist C. C. Blickenstaff says.

ARS and University of Maryland scientists found that adult weevils can be killed when exposed for only 1 second to temperatures of about 225° F., and larvae at even lower temperatures.

Tests on two alfalfa fields near Clarksville, Md., show that flaming a dormant field in March or spraying it with a mixture of malathion and methoxychlor has nearly the same effect—killing about 90 percent of the larvae. Flaming also killed up to 80 percent of the weevil's eggs and 55 percent of the adults. Flaming again after harvest kept larvae infestations nearly 70 percent below those in areas flamed only in March.

The flaming treatments also gave good control of pigweed, foxtail, and chickweed.

However, on well-established, dense stands of alfalfa, early harvest was nearly as effective as flaming or spraying. But one new, weedchoked stand was killed by weeds and weevils even though parts of it were sprayed, flamed, or harvested early.

Before flaming is recommended to farmers, scientists want to learn: (1) The best method and time to burn fields; (2) how air and soil temperatures and moisture affect flaming; (3) how deeply heat penetrates debris in which weevils or their eggs are concealed; and (4) what effects flaming has on other insects, including natural enemies of the weevil.

## **RESISTANT ALFALFA**

Release of a resistant variety within 2 to 4 years; that's the goal of ARS researchers working to develop alfalfa resistant to the alfalfa weevil.

Although resistant varieties are a desirable way to control the pest, resistance has been hard to find (AGR. RES., March 1965, p. 12, June 1966, p. 10).

Nearly every variety, experimental line, and introduction of alfalfa has been evaluated but none proved resistant or contained plants that were highly resistant. Small differences did show up among plants, however,

so research was intensified in 1965 at Beltsville, Md., and Raleigh, N.C., to screen thousands of plants to find those few with some type of resistance to the weevil.

The Beltsville team represents a joint effort of plant breeders and entomologists, led by ARS geneticist D. K. Barnes, who is responsible for plant breeding and handling plant materials, and ARS entomologist R. H. Ratcliffe, who is responsible for culturing and preparing weevils for testing. The Raleigh team is led by ARS geneticist T. H. Busbice and North Carolina State entomologist W. V. Campbell.

C. H. Hanson, Leader, Alfalfa Investigations, Beltsville, Md., coordinates the ARS program to breed weevil-resistant varieties.

The scientists are screening for three major types of insect resistance: (1) Tolerance-recovery: ability to withstand infestations; (2) weevil preference: conduciveness to egg laying and feeding; and (3) antibiosis: adverse effect of the plant on the insect. Most effort is being placed on the antibiosis type.

To select and intensify the three types of resistance in each of eight alfalfa populations at Beltsville, four main steps, or tests, are used:

- Adult cotyledon-feeding test. In each population the scientists start with about 50,000 seedlings in the cotyledon (first leaf) stage. These are infested with adult weevils. Only seedlings that show little feeding damage (some 2 to 3 percent) are saved for the next test.

- Adult leaf-feeding test. Plants that pass the first test are transplanted and grown until they have 10 to 12 leaves. Then the scientists cut disks from leaves of each plant, place them in petri dishes, and add four adult weevils to each dish. This forced feeding test allows the weevils in each dish to feed on leaf disks from only one plant; about half of the plants are

eliminated on the basis of high leaf feeding.

• Larval survival and weight test. The scientists place 10 newly hatched larvae on each remaining plant. After 3 days, surviving larvae are counted and weighed. Only plants showing antibiosis, as indicated by low weight gain or survival of larvae, are saved for the next and final test.

• Forced oviposition (egg-laying) test. Adult females are placed on the remaining plants to check their resistance to egg laying. Earlier testing has shown that adults prefer to lay eggs in alfalfa plants with hollow stems. In this test the scientists want to learn what happens when weevils have no choice of plants.

Each complete testing cycle eliminates about 99.8 percent of the original plants, leaving only 80 to 100 plants in each population for inter-crossing to produce seed for the next test cycle. From these few plants, scientists are developing resistance to the weevil. Annually, 25,000 to 50,000 plants are screened through the first stage of the program in each of the eight populations.

At Raleigh, oviposition preference is used as the first screening device. The best plants are screened successively in tests for forced oviposition and antibiosis to the larval stage.

The best experimental combinations for weevil resistance selected so far have been increased at Reno, Nev., by ARS agronomist R. N. Peaden to provide seed for new cycles of selection and for preliminary field testing. The most promising lines from the ARS field tests will be sent to State stations for performance tests under a variety of field conditions.

In the field, characteristics other than weevil resistance can be evaluated such as quality, yield, hardiness, and resistance to other pests.

## WASP PREDATORS

Wasps that lay eggs in weevil larvae are another means of control under study (AGR. RES., June 1961, p. 5; Feb. 1964, p. 6, 8).

When the eggs hatch, the young wasp larvae kill the weevil larvae. One or more types of these parasites have been released in almost every State where the weevil is a problem.



PN-1485

The alfalfa weevil prefers hollow stems as egg-laying sites.

One wasp, *Testrastichus incertus*, parasitized 64 percent of the alfalfa weevils in areas of Massachusetts where it was introduced in 1962. In other parts of Massachusetts, the wasp *Bathyplectes curculionis*, parasitized about 45 percent of the weevils in the same period.

ARS and State scientists are watching the wasps' progress in Illinois, Indiana, Missouri, New York, Ohio, and Vermont, where they were released in 1965 and 1966, and in Maryland, Pennsylvania, and New Jersey where they were first released in 1959. It is too soon, however, to evaluate their eventual usefulness.

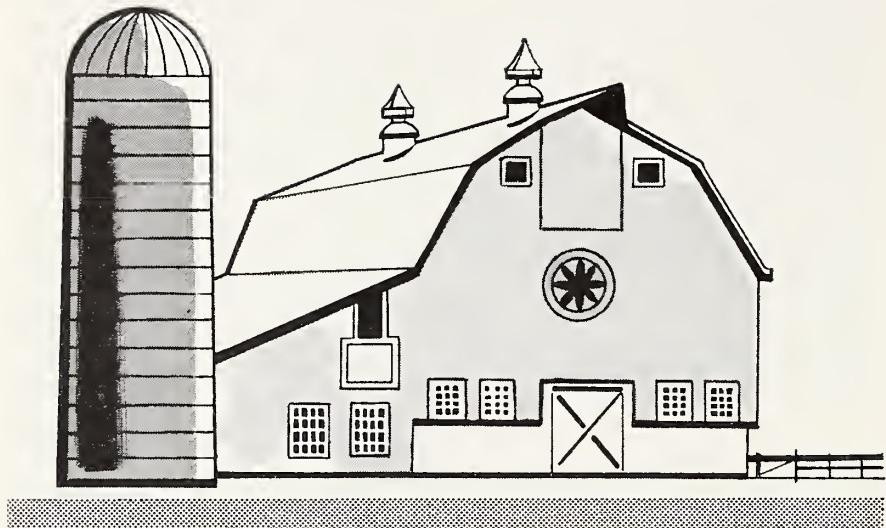
Other kinds of parasites that attack adult weevils, eggs and pupae are being released as rapidly as possible.

Even if these natural enemies of the alfalfa weevil are successful in the East and Midwest, results in the West indicate that the wasps cannot alone be expected to eliminate the pest. Over 90 percent of the weevils in the West have been parasitized by *Bathyplectes curculionis*, yet considerable crop damage continues. ■



Beneficial wasp deposits eggs in alfalfa weevil larva. Eggs hatch into larvae within the host, then kill it.

BN-13591



*No Vitamin A Deficiencies in . . .*

## **DAIRY CALVES FED CORN SILAGE**

**D**AIRY CALVES GROW normally without developing vitamin A deficiencies when fed corn silage along with high-concentrate rations, ARS tests show.

Although corn silage costs less and is often more available than alfalfa hay, other studies indicated that steers developed vitamin A deficiencies when fed either all-concentrate rations or rations high in corn silage.

To see if such vitamin A deficiencies also occur in dairy calves, ARS animal nutritionist R. W. Miller fed corn silage in a typical high-concentrate calf ration to 12 Holstein calves. Miller also studied the role of nitrates in vitamin A depletion.

Test results showed that corn silage carotene (precursor of vitamin A) was converted to vitamin A as efficiently as alfalfa carotene. Added

nitrates had no adverse effect on this conversion.

The primary indicator of vitamin A status in the calves tested was change in the pressure of cerebrospinal fluid. Increased pressure is one of the first signs of vitamin A deficiency. Carotene and vitamin A levels in blood plasma, which carries both substances, and vitamin A level in the liver, which stores the vitamin, were also used as indicators.

As Miller fed more corn silage to the calves, carotene and vitamin A levels in the blood plasma increased, cerebrospinal fluid pressures decreased, but the amount of vitamin A in the liver stayed the same. However, average daily gain was lower for the calves fed the lesser amounts of corn silage.

In the feeding tests, the calves were

fed whole milk, alfalfa hay, and all they would eat of a grain mix that contained yellow corn meal. This diet provided a normal amount of carotene.

When the test calves were 61 days old, the original grain ration was replaced with one low in carotene and reconstituted dry skim milk was substituted for the whole milk. The alfalfa hay was removed from the calves' ration when they were 91 days old, which further lowered their carotene supply.

When the calves ranged in age from 91 to 155 days, Miller divided them into four groups and began feeding each group a different quantity of corn silage. The lower two quantities of corn silage provided carotene in levels below normal requirements for vitamin A. If the carotene in corn silage is converted to vitamin A as efficiently as the carotene in alfalfa hay, the higher two quantities of corn silage provided enough carotene to prevent vitamin A deficiency in the calves.

Miller also fed potassium nitrate at different levels to two dairy calves in each of the four groups. As a control, he did not feed additional nitrate to the third calf in each group.

Other tests with steers had shown that the vitamin A reserve in the liver depleted more rapidly in steers fed high-nitrate silage than in steers fed low-nitrate silage. Nitrate levels in corn silage vary with weather conditions during plant growth, the amount of nitrogen fertilizer applied, and the age of the plants at harvest.

Calves receiving the added nitrate made normal growth for their group. The added nitrate had no adverse effect on the conversion of carotene to vitamin A.

ARS animal nutritionists L. A. Moore and D. R. Waldo and physiologist T. R. Wrenn participated with Miller in the study. ■

# FOR APPALACHIA NO-TILLAGE FARMING

**P**RESCRIPTION FOR halting erosion from plowed fields: Don't plow. Just kill weeds and sod with an herbicide, then drill seeds directly into the sod.

ARS scientists recently completed another in a series of experiments with untilled fields—this time on hilly land in the Appalachia country of eastern Ohio. Their untilled plot yielded as much corn as a conventionally tilled plot, and erosion from the untilled plot was less than a tenth of a ton per acre compared to 2.8 tons per acre from the tilled plot.

Because no-tillage farming involves fewer trips across the field, it represents a means of cost-cutting to farmers. It is also attracting wide interest among conservationists. Cultivation often causes erosion and subsequent siltation of waterways.

L. L. Harrold, hydraulic engineer at

the North Appalachian Experimental Watershed at Coshocton, Ohio, applied herbicide (2-chloro-4-ethyl-amino-6-isopropylamino-s-triazine) to his experimental plot a few weeks prior to corn planting. He used 4 pounds, or \$14 worth, of herbicide per acre. Weed and grass control was good—a prime requisite to no-tillage farming, Harrold emphasized.

Corn was planted with a specially designed planter featuring a disk that opens up a slot in the sod. Fertilizer was placed in the slot ahead of and deeper than the seed. No other field work was done until harvesting. The control plot was plowed, disked, and harrowed in the traditional manner.

Manure was applied to both plots. The plant residue and manure left on the surface of untilled soil served as a mulch, holding soil particles in place and improving the moisture

holding capacity of the soil.

Yields for the 3 years of the study were 136, 106, and 117 bushels per acre from the untilled plot; and 95, 106, and 97 bushels per acre from the conventionally tilled plot. The test years were unusually dry; the mulching effect of the crop residue on the untilled plot undoubtedly contributed to higher yields.

The plots were located on an ARS experimental watershed where instruments were available for measuring runoff and soil loss. The soil on the plots is Muskingum silt loam with an average slope of 9.4 percent.

Harrold's work is conducted in cooperation with the Ohio Agricultural Research and Development Center at Wooster. Further tests are planned to determine whether no-tillage farming is practical under a wide variety of weather and soil conditions. ■

*For no-tillage farming, a corn planter seeds directly into the sod.*

PN-1480





BN-28831

## LASER BEAM CONTROL

**T**HE LASER HAS become a tool for agriculture.

ARS agricultural engineer J. L. Fouss is using the brilliant beam of a laser to control the depth of a machine which continuously lays plastic pipe for field drainage.

Fouss and ARS technicians N. R. Fausey and W. B. Hessel developed the method at the Columbus, Ohio, headquarters for ARS drainage research, in cooperation with the Ohio Agricultural Research and Development Center.

They have tested the machine successfully under field conditions. After further tests this year, Fouss expects it to be ready for commercial production.

The engineer envisions other related uses for the laser. He believes it might be used to assure a constant level for such jobs as earthmoving, land leveling, ditching, and road grading.

The laser, invented in 1960, has found a variety of uses in industry, medicine, and photography. Laser beams drill holes in tiny diamonds, prevent blindness in humans by welding torn retinas into place, and take three-dimensional photographs without lenses.

The letters in the word laser stand for Light Amplification by Stimulated Emission of Radiation. A laser concentrates light, then emits it in a straight narrow beam. This is possible because laser light is entirely of one wavelength. Incandescent light, from an ordinary electric bulb, is of several wavelengths—thus it fans out instead of remaining straight.

Lasers capable of cutting holes in thick, solid objects produce pulsating light. Fouss, however, uses a low-energy laser that doesn't cut solid objects, but produces light in a constant beam.

CALLED A GAS LASER, it is contained in a case 14 inches long, 4 inches wide, and 6 inches high. It consists of a 12-inch glass tube, filled with helium and neon, with parallel mirrors at either end. One mirror is entirely reflective; the other is highly but not totally reflective.

The laser is electrically operated; a rectifier converts alternating current to direct current. The direct current, applied to positive and negative poles on the glass tube, activates the molecules of helium and neon, thus causing the tube to glow.

Light from the tube bounces off the

mirrors; light that passes the mirror, which is not totally reflective, becomes the brilliant red laser beam.

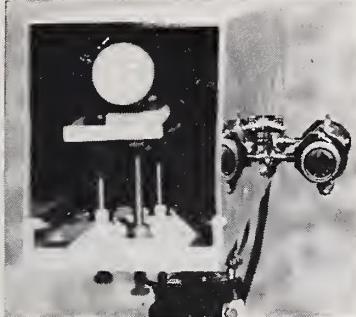
Fouss has used the laser beam for depth control at distances up to 1,500 feet. He believes it could be detected as far away as 2,500 feet, and possibly much farther.

The engineer and his associates developed their system to provide farmers with better and more economical field drainage.

Often, Fouss believes, farmers don't install adequate drainage systems because of their cost. The clay or concrete tile commonly used for field drainage is low in cost, but ditching to install it is expensive and time-consuming.

The machine Fouss uses to lay plastic pipe eliminates the need for ditching. Called a mole plow, it consists mainly of a vertical blade with a horizontal "torpedo" at the bottom, mounted on the rear of a crawler tractor and raised and lowered by the tractor's hydraulic system. Underground, the torpedo tunnels much as a mole does.

**BEHIND THE MOLE PLOW,** Fouss and his coworkers built a hollow vertical shaft. When the mole plow



*ARS agricultural engineer J. L. Fouss aims the laser beam projection unit toward the plow. Above: The projection unit with cover removed reveals the tube that originates the beam.*

## IPE DEPTH

starts tunneling, plastic pipe is fed into the shaft and is pulled through the tube and laid underground. Driving the tractor's tread over the drain line closes the gap in the soil created by the mole plow.

With their system, the researchers use corrugated plastic pipe, 2½ to 3 inches in diameter, perforated to admit water to the drain. This pipe, Fouss explains, is low in cost, lightweight, and stable under the weight of the soil. The mole plow can lay 2,000 feet of plastic pipe per hour—about the amount of clay tile that can be laid in one-half day.

**FOR PROPER DRAINAGE**, it's essential that the pipe be laid on a constant grade of at least 0.2 feet of slope for every 100 feet of pipe. Without some means of grade control it's impossible for the tractor driver to accurately adjust the mole plow depth to compensate for dips and humps in the field.

In Fouss' system, electronic circuits guided by the laser beam control the depth of the mole plow. The laser, mounted on a tripod, is sighted by a telescope with cross-hairs so that the beam will be parallel to the slope desired for the drain.

Mounted on the frame of the mole plow is the laser beam detector; and on the tractor frame, the main control box. Both are metal boxes equipped with electronic circuitry.

The detector box consists mainly of two parallel rows of photoelectric tubes. These pick up light from the laser and transmit voltage to the control box. A fan mounted in front of the laser "chops" its light so that it is transmitted at 150 cycles per second; filters in the control box pick up voltage with only that frequency, thus bright sunlight doesn't affect the system.

Laser light fans out slightly over long distances. Fouss has installed a 10-power telescope in front of his laser so its beam will fan out even less. The beam as it leaves the tele-

scope is about ½-inch in diameter; at 1,500 feet it's about 4½-inches in diameter.

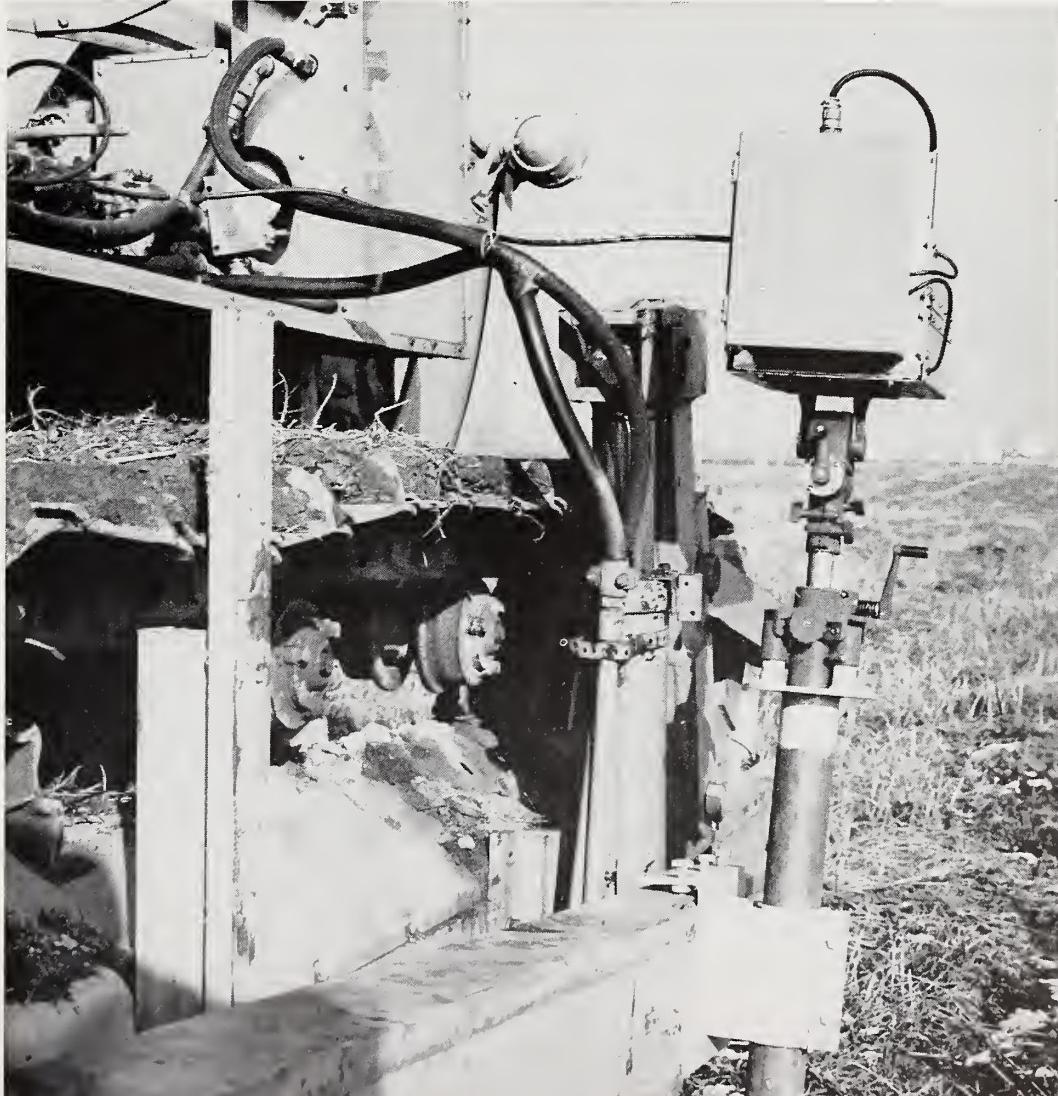
The laser is positioned so that the beam will hit directly between the two photo tubes, and each will receive the same amount of light when the mole plow is on course.

If the mole plow hits a rise or a depression, one row of photo tubes receives more light than the other row.

When this happens, the electronic circuits in the control box automatically activate the mole plow's hydraulic system to bring the plow back on course.

Lights on the control box tell the tractor driver if the mole plow is on or off course; a red light warns him if the detector is no longer picking up the laser light. The driver has con-

*The detector unit and the main control box are mounted on the mole plow frame. The laser beam projection unit is set up on a tripod at a distant point directly in front or behind the mole plow.*



## LASER BEAM

trols with which he can override the automatic system in case of emergency.

The researchers designed their system to operate for a variation of  $\frac{1}{2}$ -inch up or down from the desired grade. In their tests, it responded to variations of only  $\frac{3}{8}$ -inch at 1,500 feet.

Fouss plans to test the mole plow-laser system more intensively this year.

He has equipped a trailer with electronic instruments to test the accuracy of the system in the field. To better understand the system, the engineer will simulate its operation on an electronic analog computer.

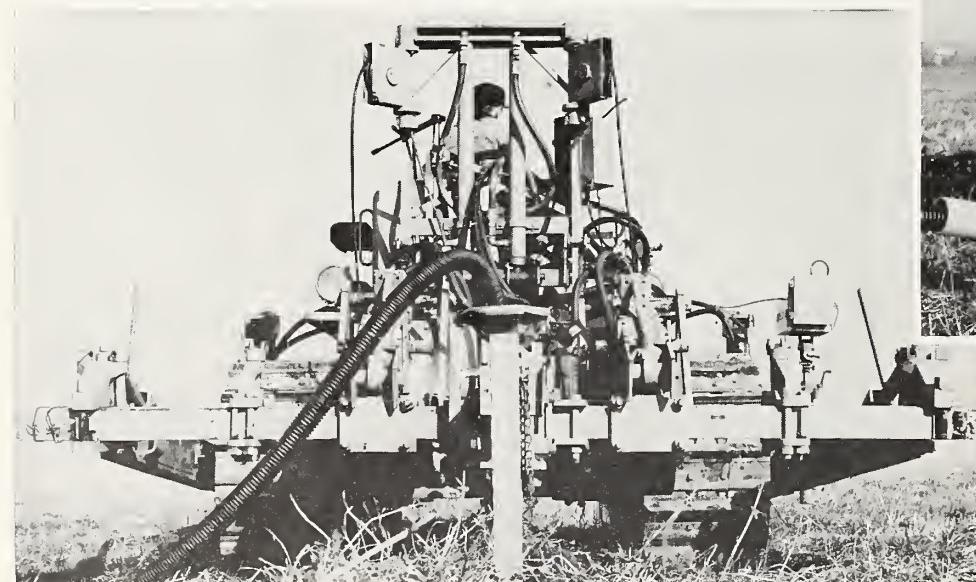
In the tests, the researchers plan to try rotating or "sweeping" the laser light about a field so that the laser will

not have to be reset each time a new drain is laid.

They will test drain pipe made of different plastics in different strengths for its ability to withstand pressure from the soil and provide satisfactory drainage.

In addition, Fouss plans to mount a spindle which can carry a roll of 600 feet of plastic pipe on the mole plow frame.

Fouss and his coworkers also plan to work toward incorporating the laser grade control system on a conventional ditching machine for use in laying clay or concrete drain tile. And, by adapting the main control box to operate the tractor's steering mechanism as well as the mole plow, they may use the laser to steer the machine automatically. ■



BN-28830

*Corrugated plastic tubing is fed through the hollow-bladed installation tool attached behind the mole plow (above, right). As the plow tunnels through the ground, the tubing is pulled through the shaft and laid underground. (above).*



BN-28822

PN-1481



### Roof Style Marks



*The shelter utilizes the opposing curve principle—one arching up, one down—in each of the three sections that form the triangular roof.*

## UNIQUE PICNIC SHELTER

A UNIQUELY DESIGNED picnic shelter ideal for family cookouts or recreation has been developed by ARS engineers at Beltsville, Md.

The shelter utilizes hyperbolic-paraboloid roof sections, a relatively new principle. These roofs are stronger and probably cheaper than most conventional beam-and-rafter roofs. The structure needs fewer supports and more headroom is available because rafters are eliminated.

The roofs derive their strength from mutually supporting arches that cross at right angles. One arch curves up, the other down, a principle borrowed from nature. The tent caterpillar's nest, for example, gains strength by being curved in two directions.

The picnic shelter is designed as a triangular roof consisting of three sections. The roof covers 693 square

feet. The three wooden posts supporting the roof are placed 20 feet apart and stabilized by concrete in the ground.

To construct each roof section, two layers of  $\frac{1}{4}$ - x 12-inch hardboard strips are crossed and their ends nailed to 2- x 8-inch boards forming the frame. Fastening temporary 2- x 4-inch rafters at equal distances to the frame allows a builder to curve the strips and prevent sagging.

Fiberglass fabric is sandwiched between the two layers of strips to bridge any gaps between the strips. Once the fabric is in place, the two layers of strips are bolted together. Then the strips are trimmed, the ridges are covered with a roll material, and the overhang is bound with sheet metal.

The surface is then waterproofed with two coats of stabilized asphalt. This coating will protect the shelter

from the weather for about 2 years. The roof should then be waterproofed again to prevent pinholes from occurring between intersections of the hardboard strips.

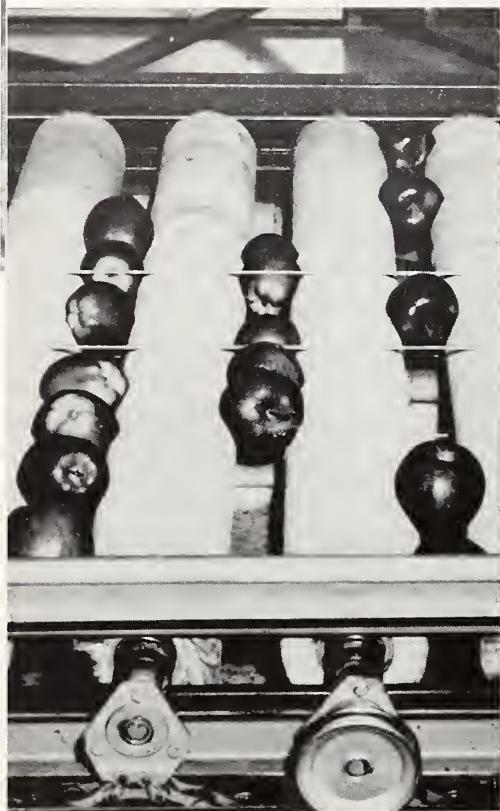
As many as six triangular roofs can be joined to form a hexagonal (six-sided) building. The technique involves using pipes instead of wooden posts for interior support. The pipes then become storm drains through which roof water flows to a disposal line installed under the building.

Material to build the picnic shelter can be purchased from a hardware and lumber store at a total cost of about \$450 per shelter.

Working drawings of the shelter (Plan 5995 "Picnic Shelter") can be obtained from extension agricultural engineers at State universities. There usually is a small charge.

USDA does not distribute working drawings. ■

*As the apples move from beginning to end of the sizing section, the gaps between the brushes gradually widen so the small apples drop through first and the large apples last.*



BN-28076

# Brush-Sizer for Apples

**A**PPLES, LIKE BABIES, need lots of TLC—tender loving care.

A radically new machine, called the unitized brush-sizer, provides this tender care while sorting, sizing, and brushing tender Golden Delicious apples in tests under commercial conditions at Monitor, Wash.

The unitized brush-sizer, developed by ARS engineers S. W. Burt and G. O. Patchen, at Wenatchee, Wash., takes considerably less space than conventional grading and sizing equipment, but fits in easily with dumpers, float tanks, chemical applicators, and packing and filling equipment now used.

In existing packing lines, the greatest damage occurs when the fruit is transferred from one piece of equipment to another. A typical grading line transfers fruit nine times. Though no particular transfer point is likely to cause serious bruising, almost every fruit receives some small

injuries because of the large number of transfers.

The injuries, usually not noticeable during sorting, show up later in the market as blemishes, small pits, and bruises which reduce quality and marketability.

With the unitized brush-sizer, the apples are nestled between two soft brushes during sorting, brushing, and sizing for maximum protection against bruising. The apples are transferred only once and do not touch each other during this transfer.

The brush-sizer improves sorting because the apples move past the sorters in a straight line at  $5\frac{1}{4}$ -inch intervals. Each sorter is responsible for the fruit in only one lane, grading the rotating apples as they are carried past. Research has shown this lane procedure to be the most efficient. And the unit sorts the apples into eight different sizes and moves them to the packing line without bumping

## PULP TRAYS FOR PEARS

**P**ACKAGING PEARS AT shipping point in specially designed trays of molded pulp reduces bruising while providing an attractive display package.

The consumer trays also permit better merchandising—they offer an opportunity for brand identification and a more effective way to give consumers recipes and handling and ripening instructions.

Pears ripen in transit and bruising often results when these soft, ripe pears are packaged at the store or handled by customers. Packaging at shipping point when pears are green and firm causes less bruising.

The standard wooden boxes now used for shipping pears are difficult to open and close, and require more labor because pears must be individually wrapped in tissue paper. Even then, they are often bruised when the box lid is fastened to hold them in place.

The new trays and fiberboard shipping containers, designed and tested by ARS agricultural economist J. B. Fountain, Yakima, Wash., and ARS marketing specialist P. G. Chapogas, Beltsville, Md., reduced bruising in 200 carloads shipped from the Pacific coast to New York City.

The trays will take nine of the com-

mercially important sizes of Anjou, Bartlett, Bosc, and Comice pears. The pears are placed in the trays with their necks resting on a smoothly rounded center divider.

The filled trays are wrapped with shrinkable plastic film that holds the pears in place. Twenty-five or thirty trays are packed in fiberboard containers.

Packaging pears in trays at shipping point costs about  $1\frac{1}{2}$  cents more per pound for materials, transportation, storage, and overhead. The retailer, however, saves at least that much and has a better quality product to offer the consumer. ■

# HIGH PROTEIN SOYBEANS

them together, a common problem with present methods.

Another important feature allows the brushes to be washed, rinsed, and dried while they are in use. This is not possible with present equipment. Plus, rotten apples crossing the brushes leave a trail of microorganisms to infect the apples that follow. Wax can also build up on the bristle tips to the point where they act as small hammers to injure the fruit.

Although designed primarily for Golden Delicious apples, the machine is expected to handle pears and peaches as well. It may prove applicable to other fruits and vegetables too.

For further details, request a copy of publication ARS-52-18, "Grading and Sizing Apples with Brushes" from the Transportation and Facilities Research Division, ARS, USDA, Federal Center Building, Hyattsville, Md. 20782. Please include your ZIP code. ■

**S**OYBEANS, ONE OF our cheapest sources of protein, may soon provide even more protein for livestock feed and for human consumption.

Average composition of soybean varieties currently grown is 40.5 percent protein and 21 percent oil. In contrast, experimental varieties developed and tested by ARS and State agricultural experiment stations have yielded from 10 to 12 percent more protein than present commercial varieties.

In experiments at the State Agricultural Experiment Station, Stoneville, Miss., ARS agronomist E. E. Hartwig produced an experimental line, called D60-9647, with 45.1 percent protein and 19.4 percent oil. Lee, the variety most commonly grown in the South, yielded 40.7 percent protein and 21.9 percent oil in the Stoneville tests.

To produce D60-9647, Hartwig crossed and recrossed soybean breeding lines to combine high protein content and good agronomic qualities. In these crosses, he used breeding lines high in protein but with poor yields and disease resistance, and lines with high yield and disease resistance but low protein content.

D60-9647 is lower in protein than some of the lines used in the crosses that produced it. However, in the Stoneville tests it yielded 2,376 pounds per acre, compared to 2,328 for Lee.

In the past, the major emphasis

in soybean development has been for varieties with a high percentage of oil. Soybean oil came into prominence during World War II as a replacement for imported vegetable oils. Meal, a byproduct, was sold for livestock feed.

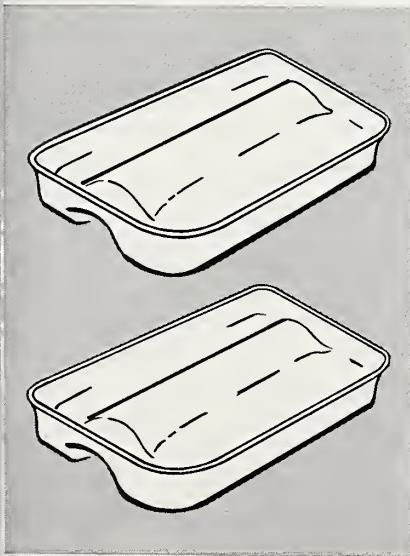
Expanded markets for high-protein meal as a livestock feed have increased its value. On the basis of 10-year averaged prices of meal and oil, meal has accounted for 58 percent of the total value of soybean crops.

Under the present marketing system, however, it still would not pay farmers to grow high-protein soybeans. High-protein soybeans have a lower oil content than standard varieties, and processors want soybeans with a high oil content because oil is worth more than meal per pound.

Hartwig, a pioneer in soybean research and development in the South, foresees a change in this marketing pattern. As demand for meat continues to increase, he believes that demand for high-protein livestock feed will also increase. Development of soybean-protein foods for underdeveloped countries will also increase market demand for high-protein soybeans.

Progress in developing high-protein soybeans is still behind that in developing improved, high-oil varieties. But when the demand develops, Hartwig expects that highly productive high-protein varieties will be available. ■

PN-1483



New Treatment for

## WATER-REPELLENT LEATHER



ST-1381-2

*ARS chemist F. P. Luvisi demonstrates the water-repellency of the leather lubricated with ASA.*

PRODUCERS OF water-repellent leather can significantly reduce the amount of repellent needed by following a new processing method developed by ARS scientists.

A heavy application of repellent—usually an expensive silicone compound—is normally required to make leather resist water satisfactorily. This is mainly because oils or greases are applied to lubricate fibers, in a process called fatliquoring, before the repellent is added.

Conventional fatliquoring com-

pounds are essentially wetting agents and work at cross purposes with the repellent. To overcome their effect, more repellent is required.

Alkenyl succinic acid (ASA) has a similar lubricating effect on leather fibers but is not a strong wetting agent. However, the only way known to apply the compound was to wring out the wet leather during processing and dip it into a solution of ASA and mineral spirits, a method hard to control and completely unsuited to tannery practice.

Recognizing the advantages of lubricating leather with ASA, chemists F. P. Luvisi, W. J. Hopkins, E. M. Filachione, and J. Naghski, of the Eastern utilization research laboratory, Philadelphia, found a way to emulsify ASA for easy application to leather in a conventional fatliquoring drum.

They worked first with only chrome-tanned leather, but after discovering that chrome-tanned leather retanned with glutaraldehyde was softer and much more receptive to fatliquoring, they included glutaraldehyde-retanned leathers in the study.

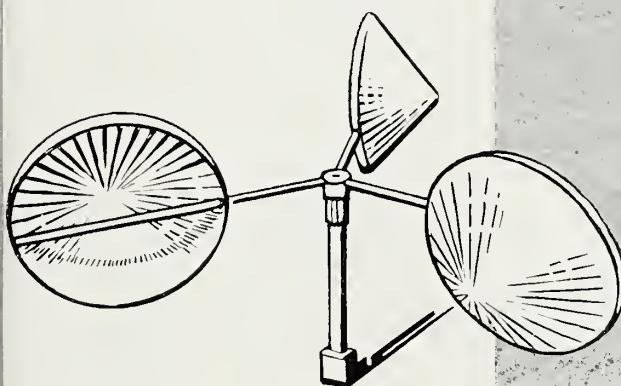
Glutaraldehyde tanning, also developed at the Philadelphia laboratory, is widely used today to make leather for items that must be laundered or must withstand exposure to perspiration, acids, or alkalis.

In the tests, the chemists used ASA to fatliquor sides of leather that had been chrome-tanned and sides that had been retanned with glutaraldehyde. Half of the sides were treated with the silicone water-repellent compound at full strength; the other half were treated at half strength.

Samples were then flexed in water to determine how long the treated leather could resist penetration. As expected, the results were highly variable because of the inherent lack of uniformity in hide structure.

The glutaraldehyde-retanned, ASA-fatliquored samples, however, showed excellent repellency, even when only half-strength silicone compound was used. In most cases where the silicone was used full strength, better repellency was achieved with ASA than with conventional fatliquoring on both chrome-tanned and glutaraldehyde-retanned leathers. At half strength, however, the glutaraldehyde-retanned ASA-lubricated leather was definitely superior to leather tanned only with chrome and processed conventionally. ■

ARS meteorologist L. J. Fritschen (right) and technician Kenneth Mullins stack windgages to measure variations in movement of several layers of air within the microclimate.



PN-1484

## Windgage Records Surface Breezes

A WINDGAGE SENSITIVE enough to measure a baby's breath has been developed by an ARS meteorologist in Arizona.

The gage resembles ordinary anemometers in most ways, but the cups that catch the wind are cone-shaped instead of hemispherical and are constructed of almost weightless plastic. Both features contribute to the sensitivity of the device.

Agricultural scientists are becoming increasingly interested in air motion within the "microclimate"—that portion of the atmosphere that lies immediately above the surface of a field. Light winds at earth's surface cool growing plants, carry carbon dioxide to leaves for use in photosynthesis,

and undoubtedly influence water-use efficiency of crops (AGR. RES., March 1967, p. 15). Standard anemometers do not record low enough wind speeds to be useful in microclimate studies.

L. J. Fritschen, formerly of the U.S. Water Conservation Laboratory in Phoenix, tested several anemometer designs in a wind tunnel, finally selecting one with cup arms made from polystyrene and cups molded from thin plastic film.

The anemometer is compact, portable, easy to dismantle and clean, and accurate within a wide range of windspeeds. Most important, it is sensitive to windspeeds of less than a tenth of a mile per hour.

The improved anemometer also features a frictionless recording system. The spinning shaft of the anemometer interrupts a beam of light focused on a photoelectric cell; the cell notes the frequency of interruptions and relays the count to an instrument that automatically calculates and records windspeed.

Several cup assemblies can be mounted one above the other to measure variations in the movement of different layers of air.

The research, which is supported in part by the U.S. Army's Atmospheric Science Research Division, should add a new degree of accuracy to wind measurements within the microclimate. ■

**AGRISEARCH NOTES**

**Adapting Recipes to Instant Flour**

When is a cup of flour more than a cup of flour?

When it's instant flour, say ARS researchers. They recommend that when homemakers bake with instant flour, they take 2 level tablespoons out of each cup of flour called for by the recipe.

A full measure of instant flour in a cake or cookie recipe designed for regular flour can—as many homemakers across the country have discovered—alter the shape, texture, and flavor of the final product. ARS food specialists R. H. Matthews and E. A. Bechtel conducted a series of baking tests to make instant flour more compatible with standard recipes.

Instant flour is processed with steam or hot water after regular milling to make tiny granules stick together as larger particles, thus taking up less space in a measuring cup. Because of this characteristic, instant flour mixes more readily with water without forming lumps and is therefore a handy product for making gravy.

For baking, however, this same characteristic causes problems. The instant flour weighs more per cup and takes up liquid at a faster rate than regular flour. This has the net effect of providing too much flour for the dough in relation to the liquid. For example, in popovers the batter does not contain enough water to provide adequate steam for the product to "pop" properly.

Matthews and Bechtel, following findings from preliminary tests, showed that in 10 baked products tested, the imbalance in ingredients can be corrected by taking 2 tablespoonsful from each cup of flour measured out.

They tested two brands of instant flour against one brand of sifted, regular, all-purpose flour for muffins, drop biscuits, waffles, popovers, yeast rolls, coffeecake, plain cake, cream puffs, cookies, and pastry.

Taste panels rated the adjusted recipe with both brands of instant flour as good as the recipe made with the normal amount of regular flour in most cases.

For pastry, taste and appearance can be improved further by adding more fat to the dough, Matthews and Bechtel say. Some companies making instant flour already suggest that extra fat be added to the product to help overcome the tendency of instant flour to soak up water. Although a little extra fat helps, Matthews and Bechtel warn that adding extra water to the dough is no solution. That destroys the proper balance between ingredients and tends to ruin the baked product.

**Green-Seeded Fordhook Lima**

From India came a speckled-seeded pole lima bean with downy mildew resistance.

In the United States, ARS scientists incorporated this resistance into the first Fordhook lima bean variety with green seeds.

The new variety, named Green Seeded Fordhook, was developed by ARS plant breeder R. E. Wester at

Beltsville, Md., from crosses of Plant Introduction No. 164155 from India, Early Thorogreen, Concentrated Fordhook, and Fordhook 242.

Downy mildew, a fungus disease, causes heavy losses in lima beans, particularly in wet seasons. Under conditions ideal for development of the fungus, the young leaves are killed and the pods shrivel, wilt, and die. The disease is most common along the Atlantic seaboard.

Green Seeded Fordhook, recommended for the Middle Atlantic Coastal area, will outyield Fordhook 242, the leading Fordhook variety, by 30 to 60 percent when downy mildew is present.

The new variety is compact, not as bushy as Fordhook 242. The pods are concentrated in the crown of the plant and reach prime-marketable condition 4 to 6 days later than Fordhook 242. The beans of Green Seeded Fordhook, while slightly smaller than those of Fordhook 242, have the very desirable characteristic of remaining succulent in the field 5 to 8 days longer.

Seeds will be available to growers for planting in 1968.

**CAUTION:** In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

